STATISTICAL SCIENCES (STAT)

STAT 206. Data Analysis and Statistics for Elementary Education. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Enrollment is restricted to students majoring in liberal studies for early and elementary education who have received a passing score on the PRAXIS I exam. Understanding probability, describing data both graphically and numerically, regression/correlation, common distributions and interpretation, item analysis for tests, interpreting test scores and educational studies, experimental design and limitations, comparing results using t-tests. This course relies heavily on using a graphing calculator as a data-analysis tool. Students may receive credit toward graduation for only one of STAT 206, STAT 208, STAT 210, STAT 212, STAT 312 or SCMA 301.

STAT 208. Statistical Thinking. 3 Hours.
Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Prerequisite: satisfactory score on the VCU Mathematics Placement Test within the one-year period immediately preceding the beginning of the course, or a minimum grade of C in MATH 131, MATH 139, MATH 141, MATH 151, MATH 200 or MATH 201. An exploration of the use of statistics in the world around us through in-depth case studies. Emphasis is on understanding statistical studies, charts, tables and graphs frequently seen in various media sources. Some lectures involve activities centered on case studies. Students may receive credit toward graduation for only one of STAT 206, STAT 208, STAT 210, STAT 212, STAT 312 or SCMA 301.

STAT 210. Basic Practice of Statistics. 3 Hours.
Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Prerequisite: satisfactory score on the VCU Mathematics Placement Test within the one-year period immediately preceding the beginning of the course, or MATH 131, MATH 139, MATH 141, MATH 151, MATH 200 or MATH 201. Designed for students who will likely take another quantitative reasoning course for which statistics may be a prerequisite. Not open to mathematical sciences or computer science majors. Topics include examining distributions, examining relationships, producing data, sampling distributions and probability, introduction to inference. Students may receive credit toward graduation for only one of STAT 206, STAT 208, STAT 210, STAT 212, STAT 312 or SCMA 301.

STAT 212. Concepts of Statistics. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: satisfactory score on the VCU Mathematics Placement Test within the one-year period immediately preceding the beginning of the course, or MATH 151, MATH 200 or MATH 201. Introductory statistics course with an emphasis on descriptive statistics, correlation and regression, probability, normal distributions, t distributions, and statistical inference. Appropriate technology/software will be used to illustrate concepts and analyses. A core course for mathematical sciences. Students may receive credit toward graduation for only one of STAT 206, STAT 208, STAT 210, STAT 212, STAT 312 or SCMA 301.

STAT 291. Topics in Statistics. 1-3 Hours.
Semester course; 1-3 lecture hours. 1-3 credits. A study of selected topics in statistics. Specific topics may fulfill general education requirements. See the Schedule of Classes for specific topics and prerequisites.

STAT 305. Intermediate Statistics. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: STAT 212 or its equivalent. A study of intermediate-level statistical inference procedures, including categorical data analysis, analysis of variance, multiple regression and nonparametric procedures. Students may receive credit toward graduation for only one of STAT 305 or STAT 314.

STAT 309. Introduction to Probability Theory. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: MATH 307 and either MATH 211 or MATH 300. A study of the mathematical theory of probability, including finite and infinite sample spaces, random variables, discrete and continuous distributions, mathematical expectation, functions of random variables and sampling distributions.

STAT 310. Introduction to Statistical Inference. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: STAT 212 and STAT 309, or permission of instructor. Framework for statistical inference. Point and interval estimation of population parameters. Hypothesis testing concepts, power functions, Neyman-Pearson lemma and likelihood ratio tests. Elementary decision theory concepts.

STAT 314. Applications of Statistics. 4 Hours.
Semester course; 4 lecture hours. 4 credits. Prerequisite: STAT 210 or 212. A study of the concepts and application of statistical methods including: estimation and hypothesis testing for two sample problems; one factor analysis of variance and multiple comparisons; randomized block designs and analysis; inferences on categorical data, including chi-square test for independence for contingency tables; simple linear regression and correlation; multiple linear regression. Special topics include distribution-free (nonparametric) methods in various statistical problems, two factor analysis of variance and the use of a statistical software package for data analysis. Students may receive credit toward graduation for only one of STAT 305 or STAT 314.

STAT 321. Introduction to Statistical Computing for Data Science. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: STAT 212 or its equivalent. The application of computers and computing software to statistical concepts using R, SAS and other quantitative software. Topics include data storage and retrieval, data modification and file handling, standard statistical analyses, graphical representations, practical presentation of results.

STAT 350. Data Science for the Arts, Media and Political Science. 3 Hours.
Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Prerequisite: MATH 131, MATH 139, MATH 141, MATH 151, MATH 200, MATH 201, STAT 208, STAT 210, or STAT 212 or a satisfactory score on the VCU Mathematics Placement Test within the one-year period immediately preceding the beginning of the course. Introduction to the application of computers to interact with data from the arts, political science and media. Topics include computer programming concepts in R, data acquisition, data structures, working with data, graphical representation, correlation, regression, time series analysis and statistical inference from a critical perspective applied to arts, political science and media. The course is designed for students with limited background in computer programming and is not applicable toward the B.S. in Mathematical Sciences.

STAT 351. Data Science for Health Sciences. 3 Hours.
Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Prerequisite: MATH 131, MATH 139, MATH 141, MATH 151, MATH 200 or MATH 201 or a satisfactory score on the VCU Mathematics Placement Test within the one-year period immediately preceding the beginning of the course. Introduction to the key concepts and techniques of data science and their applications in the health sciences. Students will gain practical skills in data acquisition via web devices, data wrangling, visualization and basic statistical analyses of the data using R. The course will focus on collecting and preparing data for health care settings and implementing basic statistical techniques including repeated measurement analysis. The course is designed for students with limited background in computer programming and is not applicable toward the B.S. in Mathematical Sciences.

STAT 352. Data Science for Engineers. 3 Hours.
Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Prerequisite: MATH 131, MATH 139, MATH 141, MATH 151, MATH 200 or MATH 201 or a satisfactory score on the VCU Mathematics Placement Test within the one-year period immediately preceding the beginning of the course. Introduction to the core concepts of data science for engineering students with an emphasis on outcomes of the application of data science to broad engineering problems. Students will gain practical skills in exploratory analysis to define problems and goals; application of statistics to knowledge discovery by way of general techniques in data science, such as data acquisition, data processing, data summaries, classification, clustering and regression analysis; and techniques to generate models in a variety of domains including signal and image processing. Students will learn to use Python and Matlab for data acquisition, processing and analysis. The course is designed for students with limited background in computer programming and is not applicable toward the B.S. in Mathematical Sciences.

STAT 354. Data Science for Business. 3 Hours.
Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Prerequisite: BUSN 212 or MATH 131 or, MATH 139, MATH 141, MATH 151, MATH 200 or MATH 201 or a satisfactory score on the VCU Mathematics Placement Test within the one-year period immediately preceding the beginning of the course. Introduction to the core concepts of data science for business students with an emphasis on data processing, visualization techniques and analytical methods in a business setting. Includes introduction to computer programming concepts foundational for managing and structuring datasets, building useful graphical representations and performing statistical analysis. Students will learn use of modern software tools, such as Microsoft Excel, R, Python and Tableau. The course is designed for students with limited background in computer programming and is not applicable toward the B.S. in Mathematical Sciences.

STAT 355. Data Science for AI. 3 Hours.
Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Prerequisite: MATH 131, MATH 139, MATH 141, MATH 151, MATH 170, MATH 200 or MATH 201 or a satisfactory score on the VCU Mathematics Placement Test within the one-year period immediately preceding the beginning of the course. Introduction to the key concepts and techniques of data science and their applications in artificial intelligence. Students will gain practical skills in data wrangling, visualization, and machine learning using both R and Python. The course will focus on preparing data for AI-driven models and implementing basic machine learning algorithms. The course is designed for students with limited background in computer programming and is not applicable toward the B.S. in Mathematical Sciences.

STAT 391. Topics in Statistics. 1-3 Hours.
Semester course; 1-3 lecture hours. 1-3 credits. Prerequisite: because of the changing subject matter to be treated in this course, permission of the instructor is required. A study of selected topics in statistics. See the Schedule of Classes for specific topics to be offered each semester and prerequisites.

STAT 403. Introduction to Stochastic Processes. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: MATH 307 and STAT 309. Introduction to the theory of stochastic processes and their applications. In-depth studies of random variables, conditional probability and conditional expectation. Topics include Markov chains, random walks, Poisson processes, birth and death processes and applications to classical problems (e.g., gambler's ruin, physics, etc.).

STAT 421. Statistical Computing for Machine Learning and Artificial Intelligence. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: STAT 321. Introduction to object-oriented programming for use with statistical analyses, machine learning and artificial intelligence. Topics include basic algorithms in object-oriented programming languages (such as R / Python) and applications involving parametric and non-parametric data analysis and inference, statistical learning, simulation, deep learning and advanced data manipulation.

STAT 422. Structured Problem Solving Using Statistics. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: STAT 314, PSYC 214 or SCMA 302, or permission of instructor. Focuses on using analytic frameworks and applying statistics to solve problems in a real-world environment. Topics include discussion of analytical frameworks, problem restatement, divergent/convergent thinking, causal flow diagramming, the matrix method, decision tree analysis, review of sampling, confidence intervals, regression, ANOVA, chi squared tests, as well as applications of these concepts to solve case studies.

STAT 423. Nonparametric Statistics. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: STAT 305 or STAT 314; and STAT 321. Introduction to statistical estimation and inference methods that require relatively mild assumptions about the underlying population distribution. Topics include classical nonparametric hypothesis testing methods, permutation tests, bootstrap methods and density estimation.

STAT 425. Multivariate Statistics. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: MATH 307, MATH 310, STAT 309, and either STAT 305 or STAT 314. Completion of STAT 421 is strongly recommended. Introduction to multivariate statistical analysis methods. Topics include multivariate probability distributions and their properties, conditional and marginal distributions, multivariate normal distribution, Hotelling's T2 distribution, multivariate analysis of variance, repeated measures, multivariate regression, principle component analysis, exploratory factor analysis, linear discriminant analysis, cluster analysis, and regression trees. Students will use modern statistical software to perform these analyses.

STAT 435. Industrial Statistics. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: STAT 305 or STAT 314. Introduction to statistical methods for quality control and process improvement. Topics include special versus common causes of variation, statistical thinking in industrial settings, Shewhart control charts, capability analysis, components of variation, design of experiments and response surface methods. Incorporates use of statistical software.

STAT 441. Applied Statistics for Engineers and Scientists. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: MATH 201 or equivalent. An introduction to applied statistics intended primarily for students in engineering. The fundamental ideas about the collection and display of information, descriptive statistics and exploratory data analysis, elementary probability theory, frequency distributions, and sampling are covered. Other topics include tests of hypotheses and confidence intervals for one and two sample problems; ANOVA; principles of one-factor experimental designs including randomized complete block designs, fixed and random effects and multiple comparisons; correlation and linear regression analysis; control charts; contingency tables and goodness-of-fit. Statistical software is used extensively in this course, so a working knowledge of computers is necessary. Students may receive degree credit for only one of BIOS 543, STAT 441, STAT 541, STAT 543 or STAT 641.

STAT 443. Regression. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: STAT 305 and STAT 321, or permission of instructor. Completion of MATH 310 is strongly recommended. Introduction to the concepts and methods of linear regression, logistic regression, and other nonlinear regression models. Topics include model development and assumptions, estimation of model parameters, statistical inferences about the regression model, selection of an appropriate model, and diagnostics regarding multicollinearity and influence points. Applications involve the use of a statistical software package.

STAT 447. Introduction to Statistical Data Science. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: STAT 305 or STAT 314; and STAT 321. Familiarity with a computer programming language is strongly recommended. Introduces students to statistical concepts and tools of data science for processing, presenting and analyzing data. Topics include data visualization, data wrangling, simulation studies, statistical inference techniques and implementations, and other content that reflects the current needs of data scientists. The course takes an applied approach to provide a broad treatment of these topics from a statistical perspective. Students will be engaged in real data analysis using R and Python, progressing through data processing, exploratory techniques, statistical modeling, and interpreting and communicating analysis results.

STAT 475. Time Series. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: STAT 321 and either STAT 305 or STAT 314. Completion of STAT 421 is strongly recommended. Introduction to the modeling of univariate time series data. Topics include simple and exponential moving averages, Brown's double exponential smoothing, Holt-Winters model, autocorrelation, partial autocorrelation, autoregressive integrated moving average models, seasonal autoregressive moving average models, harmonic analysis and time series regression. Students will use modern statistical software to perform these analyses.

STAT 508. Introduction to Social Statistics. 3 Hours.
Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Introduction to statistical methods applicable in a variety of settings, with emphasis on nonexperimental data. Data description and analysis including chi-square and t-tests, using a statistical computing package. Not applicable toward M.S. in Mathematical Sciences or Computer Science. Crosslisted as: SOCY 508.

STAT 513. Mathematical Statistics I. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Enrolling students should have completed both univariate and multivariate calculus. Probability, random variables and their properties, expectations, moment generating functions,common families of distributions, multiple random variables, and sample statistics and properties. Crosslisted as: BIOS 513.

STAT 514. Mathematical Statistics II. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: STAT 513/ BIOS 513. Sufficient statistics, completeness, likelihood functions, point estimators and their properties, hypothesis tests, confidence intervals, and limit theorems. Crosslisted as: BIOS 514.

STAT 534. Statistical Data Science I. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Enrollment requires permission of the instructor or graduate director. Familiarity with computer programming is strongly recommended. Topics include processing data from multiple sources and of different types; presentation of complex data; programming statistical and machine learning algorithms, such as maximum likelihood, least squares, etc.; design, implementation and analysis of simulation studies. Other topics will be covered that reflect the current needs of data scientists.

STAT 543. Statistical Methods I. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Enrollment restricted to students with graduate standing, or those with one course in statistics and permission of instructor. Basic concepts and techniques of statistical methods, including the collection and display of information, data analysis and statistical measures; variation, sampling and sampling distributions; point estimation, confidence intervals and tests of hypotheses for one and two sample problems; principles of one-factor experimental design, one-way analysis of variance and multiple comparisons; correlation and simple linear regression analysis; contingency tables and tests for goodness of fit. Students may receive degree credit for only one of BIOS 543, STAT 441, STAT 541, STAT 543 or STAT 641. Neither STAT 543 nor BIOS 543 is applicable toward the M.S. degree in mathematical sciences or the M.S. degree in computer science.

STAT 544. Statistical Methods II. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: STAT 305, STAT 314, STAT 441, STAT 541 or STAT 543, or an equivalent. Advanced treatment of the design of experiments and the statistical analysis of experimental data using analysis of variance and multiple-regression. Includes the use of a statistical software package for data analysis. Students may receive degree credit for only one of BIOS 544 or STAT 544.

STAT 545. Applied Bayesian Statistics. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Enrollment requires permission of instructor. Students should be familiar with statistical techniques such as multiple linear regression and multi-way ANOVA. Basic probability theory, prior distributions, prior distribution elicitation, likelihood principle, conjugate prior distributions, posterior probability distributions, Bayesian inference. Analysis of typical types of experiments such as single sample experiments, two sample experiments, regression analysis, ANOVA, hierarchical models, structural equation modeling and other topics. Software such as R, Python, JAGS or STAN will be used to perform computations.

STAT 546. Linear Models. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: STAT 513 and one applied course in statistics, or permission of instructor. A study of the theory underlying the general linear model and general linear hypothesis. Topics include the general linear model for quantitative responses (including multiple regression, analysis of variance and analysis of covariance), binomial regression models for binary data (including logistic regression and probit models) and Poisson regression models for count data (including log-linear models for contingency tables and hazard models for survival data).

STAT 591. Topics in Statistics. 3 Hours.
Semester course; 3 lecture hours. 3 credits. May be repeated for credit. Prerequisite: Permission of the instructor. Course open to qualified undergraduates. Selected topics in statistics.

STAT 608. Statistics for Social Research. 3 Hours.
Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Prerequisite: STAT/SOCY 508 or SOCY 214 or permission of instructor. Statistical methods applied in social research. Topics include analysis of variance, correlation and regression, including stepwise methods, and the analysis of discrete data. Study of a statistical package, emphasizing manipulation of survey data sets. Not applicable toward M.S. in Mathematical Sciences or Computer Science. Crosslisted as: SOCY 608.

STAT 613. Stochastic Processes. 3 Hours.
Continuous courses; 3 lecture hours. 3-3 credits. Prerequisite: graduate status in mathematical sciences or systems modeling and analysis, or permission of instructor. Introduction to the theory and applications of stochastic processes. Random walks, Markov processes, queuing theory, renewal theory, birth-death and diffusion processes. Time series, spectral analysis, filter, autocorrelation.

STAT 614. Stochastic Processes. 3 Hours.
Continuous courses; 3 lecture hours. 3-3 credits. Prerequisite: graduate status in mathematical sciences or systems modeling and analysis, or permission of instructor. Introduction to the theory and applications of stochastic processes. Random walks, Markov processes, queuing theory, renewal theory, birth-death and diffusion processes. Time series, spectral analysis, filter, autocorrelation.

STAT 621. Nonparametric Statistical Methods. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: any two courses of statistics or permission of instructor. Estimation and hypothesis testing when the form of the underlying distribution is unknown. One-, two- and k-sample problems. Tests of randomness, Kolmogorov-Smirnov tests, analysis of contingency tables and coefficients of association. Crosslisted as: BIOS 621.

STAT 623. Discrete Multivariate Analysis. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: graduate status in mathematical sciences or systems modeling and analysis, or permission of the instructor. Methods for the analysis of categorical data, including logistic regression and the general log-linear model. Emphasis on social and biomedical applications of these techniques using SPSS and SAS software.

STAT 625. Applied Multivariate Analysis. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: graduate status in mathematical sciences or systems modeling and analysis, or permission of instructor. Multivariate statistics is a study of dependent random variables. This course covers methods for analyzing continuous multivariate data, such as numerical and graphical summary of multivariate observations, principal component analysis, factor analysis, classification and discrimination, canonical correlation analysis, and cluster analysis. Students will learn the motivation behind these methods, how to implement them in statistical software packages and how to interpret the results.

STAT 626. Complex Sampling Designs and Variance Estimation. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: STAT 544 and 514. The analysis of data from surveys that use multistage samples, and connections to the analysis of observational studies and experiments with missing data. Computer intensive methodologies such as the jackknife and bootstrap will be introduced and applied to the problem of variance estimation in these diverse settings.

STAT 636. Machine Learning Algorithms. 3 Hours.
Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Enrollment is restricted to students with graduate status in mathematical sciences, systems modeling and analysis, decision sciences and business analytics, or computer science, or by permission of the instructor. Includes an in-depth analysis of machine learning algorithms for data mining, equipping students with skills necessary for the design of new algorithms. Analyses will include framing algorithms as optimization problems and a probabilistic analysis of algorithms. Students will be exposed to current areas of research in the construction of data mining algorithms. Crosslisted as: OPER 636.

STAT 641. Applied Data Analysis. 3 Hours.
Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Experience with mathematics or statistics software is strongly recommended. Introduction to applied data analysis intended primarily for graduate students in mathematical sciences and engineering. Topics include the fundamental ideas of descriptive statistics, elementary probability theory, statistical inference including tests of hypotheses and confidence intervals, ANOVA, principles of experimental design, correlation and linear regression analysis, categorical data analysis, and quality control. Focus is on the practical side of implementing these techniques using statistical software packages. Students may receive degree credit for only one of BIOS 543, STAT 441, STAT 541, STAT 543 or STAT 641.

STAT 642. Design and Analysis of Experiments I. 3 Hours.
Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Enrollment is restricted to students with graduate status in mathematical sciences or systems modeling and analysis or by permission of instructor. An introduction to the design and analysis of experiments. Topics include the design and analysis of completely randomized designs, one variable block designs, the family of Latin square designs and split-plot designs. Introductions are also given to multiple comparison procedures and contrasts, analysis of covariance and factorial experiments. Applications involve the use of a statistical software package.

STAT 643. Applied Linear Regression. 3 Hours.
Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Knowledge of calculus and linear algebra recommended. An introduction to the concepts and methods of linear regression analysis. Topics include simple linear regression, multiple linear regression, the impact of model misspecification, model selection criteria, residual analysis, influence diagnostics, diagnostic plots, multicollinearity, transformations and response surface methodology. Applications involve the use of a statistical software package.

STAT 645. Bayesian Decision Theory. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: STAT 514 or equivalent. Presents statistical decision theory and Bayesian analysis, with discussions of loss functions, risk, utility, prior information; conjugate families; posterior distributions, estimation, hypothesis testing; empirical and hierarchical Bayes analysis; and robustness.

STAT 648. Systems Reliability Analysis. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: graduate status in mathematical sciences or systems modeling and analysis, or permission of the instructor. An introduction to engineering reliability and risk analysis, specifically failure data analysis, maintenance problems, system reliability and probabilistic risk assessment. Applications in computer science and engineering will include stochastic characterization of wear in hardware systems and the development of failure models for software systems. Decision problems such as the optimal maintenance of repairable systems and optimal testing policies for hardware and software systems will be examined. The analysis of risk through fault trees, event trees and accident precursor analysis also will be discussed. Crosslisted as: OPER 648.

STAT 649. Statistical Quality Control. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: graduate status in mathematical sciences or systems modeling and analysis, or permission of the instructor. Demonstrates how statistics and data analysis can be applied effectively to process control and management. Topics include the definition of quality, its measurement through statistical techniques, variable and attribute control charts, CUSUM charts, multivariate control charts, process capability analysis, design of experiments, and classical and Bayesian acceptance sampling. Statistical software will be used to apply the techniques to real-life case studies from manufacturing and service industries. Crosslisted as: OPER 649.

STAT 650. Design and Analysis of Response Surface Experiments. 3 Hours.
Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Enrollment is restricted to students with graduate status in mathematical sciences or systems modeling and analysis, or by permission of the instructor. Philosophy, terminology and nomenclature for response surface methodology, analysis in the vicinity of the stationary point, canonical analysis, description of the response surface, rotatability, uniform information designs, central composite designs and design optimality. Crosslisted as: BIOS 650.

STAT 675. Time Series Analysis I. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: graduate status in mathematical sciences or systems modeling and analysis, or permission of instructor. Analysis of data when observations are not mutually independent, stationary and nonstationary time series, ARIMA modeling, trend elimination, seasonal models, intervention analysis, transfer function analysis, prediction and applications in economics and engineering.

STAT 691. Special Topics in Statistics. 1-3 Hours.
Semester course; 1-3 lecture hours. 1-3 credits. May be repeated for credit. Prerequisite: Permission of instructor. A detailed study of selected topics in statistics.

STAT 696. Applied Project. 1-3 Hours.
Semester course; 1-3 lecture hours (to be arranged). 1-3 credits. Up to three credits will be applied to the M.S. in Mathematical Sciences (operations research or statistics concentration) per section. Can be repeated for credit. Prerequisite: SSOR 690 or permission of the faculty adviser. Designed to allow students to apply concepts and theories learned in other courses to a practical situation. Includes the selection, written description, completion and written report of the project and a presentation of the findings. Students may not receive credit for both OPER/STAT 696 and OPER/STAT 698. Graded as Satisfactory/Unsatisfactory. Crosslisted as: OPER 696.

STAT 697. Directed Research. 1-3 Hours.
Semester course; variable hours. 1-3 credits per semester. May be repeated for credit. Prerequisite: Graduate standing. Supervised individual research and study in an area not covered in the present curriculum or in one that significantly extends present coverage. Research culminates with an oral presentation and submission of a written version of this presentation to the supervising faculty member.

STAT 698. Thesis. 1-3 Hours.
Hours to be arranged. 1-3 credits. A total of 3 or 6 credits may be applied to the M.S. in Mathematical Sciences/Statistics. (A total of 3 credits for an expository thesis or a total of 6 credits for a research thesis.) May be repeated for credit. Prerequisite: Graduate standing. Independent research culminating in the writing of the required thesis as described in this bulletin. Grade of "S," "U" or "F" may be assigned in this course.

STAT 725. Advanced Multivariate Statistical Methods. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: STAT 625 and STAT 643. This course emphasizes statistical analysis, methodology and theory in modern statistical learning. A variety of multivariate statistical methods, algorithms and software tools will be introduced, with emphasis on conceptual, theoretical and computational aspects. Topics include regularized regression (linear/nonlinear), classification, clustering, sufficient dimension reduction and high dimensional data analysis. Applications involve the use of a statistical software package.

STAT 736. Mathematics of Knowledge and Search Engines. 3 Hours.
Semester course; 3 lecture hours (delivered online, face-to-face or hybrid). 3 credits. Prerequisite: STAT 636 or equivalent. Investigates the mathematics, methods and algorithms for searching for and extracting structures of interest (knowledge) from large and possibly high-dimensional datasets. The motivation is the rapid and phenomenal growth of the search engine (as demonstrated by Google) as a major tool for search on the Internet, which has impacted commerce, education and the study of social, financial and scientific datasets. The development of the mathematical and statistical learning algorithms behind these search engines has led to advances in how large, high-dimensional datasets can be effectively analyzed for the extraction of knowledge. Crosslisted as: OPER 736.

STAT 742. Design and Analysis of Experiments II. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: STAT 642. Advanced study of the design and analysis of experiments. Topics include the design and analysis of incomplete block designs, factorial designs, fractional factorial designs, asymmetric factorial designs, blocking in fractional factorial designs, nested designs and response surface designs. Applications involve the use of a statistical software package.

STAT 744. Regression II. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: STAT 643 or equivalent. Knowledge of calculus and linear algebra required. Theoretical development and advanced applications of the general linear regression model and nonlinear regression models. Topics include an overview of multiple linear regression, generalized least squares and weighted regression, procedures for diagnosing and combating multicollinearity, advanced model selection criteria, influence diagnostics including multiple observation diagnostics and singular value decomposition, nonlinear regression, Poisson regression, logistic regression, generalized linear models and the exponential family, variance modeling and nonparametric regression. Applications involve the use of a statistical software package.

STAT 745. Advanced Bayesian Statistics. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: STAT 546 and STAT 645 or permission of instructor. Introduces modern aspects of Bayesian methodology. Numerical and sampling techniques such as the Gibbs sampler, importance sampling resampling, Monte Carlo integration, Metropolis-Hastings sampling and adaptive sampling methods. Inferential methods including model selection, highest probability models, Bayesian model averaging, Markov chain Monte Carlo model composition. A large portion of the course will survey the current literature in the areas listed above as well as applications of the methods.

STAT 746. Spatial Data Analysis. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisites: STAT 513 and STAT 643 or permission of instructor. The course will introduce graphical and quantitative analysis for spatial data. Topics include data on fixed-grids, point-referenced data, lattice data, point-pattern data and experimental design for spatial data collection. Students will be expected learn how to program in appropriate software packages.

STAT 775. Time Series Analysis II. 3 Hours.
Semester course; 3 lecture hours. 3 credits. Prerequisite: STAT 513 and STAT 675, or permission of instructor. Advanced study of time series analysis. Topics include multivariate time series, state-space models and GARCH models. Applications involve the use of a statistical software package.

STAT 791. Special Topics in Statistics. 1-3 Hours.
Semester course; 1-3 lecture hours (delivered online, face-to-face or hybrid). 1-3 credits. May be repeated for credit. Enrollment requires permission of the instructor. A detailed study of selected advanced topics in statistics.